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Taguchi

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(54) **COMPRESSOR**

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F25B 43/02	(2006.01)
F04B 27/10	(2006.01)

(52) **U.S. Cl.**
CPC ***F25B 43/02*** (2013.01); ***F04B 27/10*** (2013.01); ***F04B 27/109*** (2013.01); ***F04B 27/1081*** (2013.01)

(58) **Field of Classification Search**
CPC F04B 27/1081; F04B 27/109; F25B 43/02
See application file for complete search history.

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(57) **ABSTRACT**

A compressor capable of reducing oil circulation rate with a simple structure is provided. A compressor **100** in which a piston **136** is caused to reciprocate, so that a refrigerant gas drawn from a suction chamber **141** via a suction hole **103***a* is compressed and discharged, includes: a partition member **150** dividing the suction chamber **141**, into which the refrigerant gas flows from a suction passage **104***a*, into a first space **141***a* connected to the suction passage **104***a* and a second space **141***b* connected to the suction hole **103***a*; and a communication passage **150***a* configured to allow the first space **141***a* and the second space **141***b* to be in communication with each other, and introduce the refrigerant gas, from which lubricating oil has been separated, from the first space **141***a* to the second space **141***b*.

6 Claims, 8 Drawing Sheets

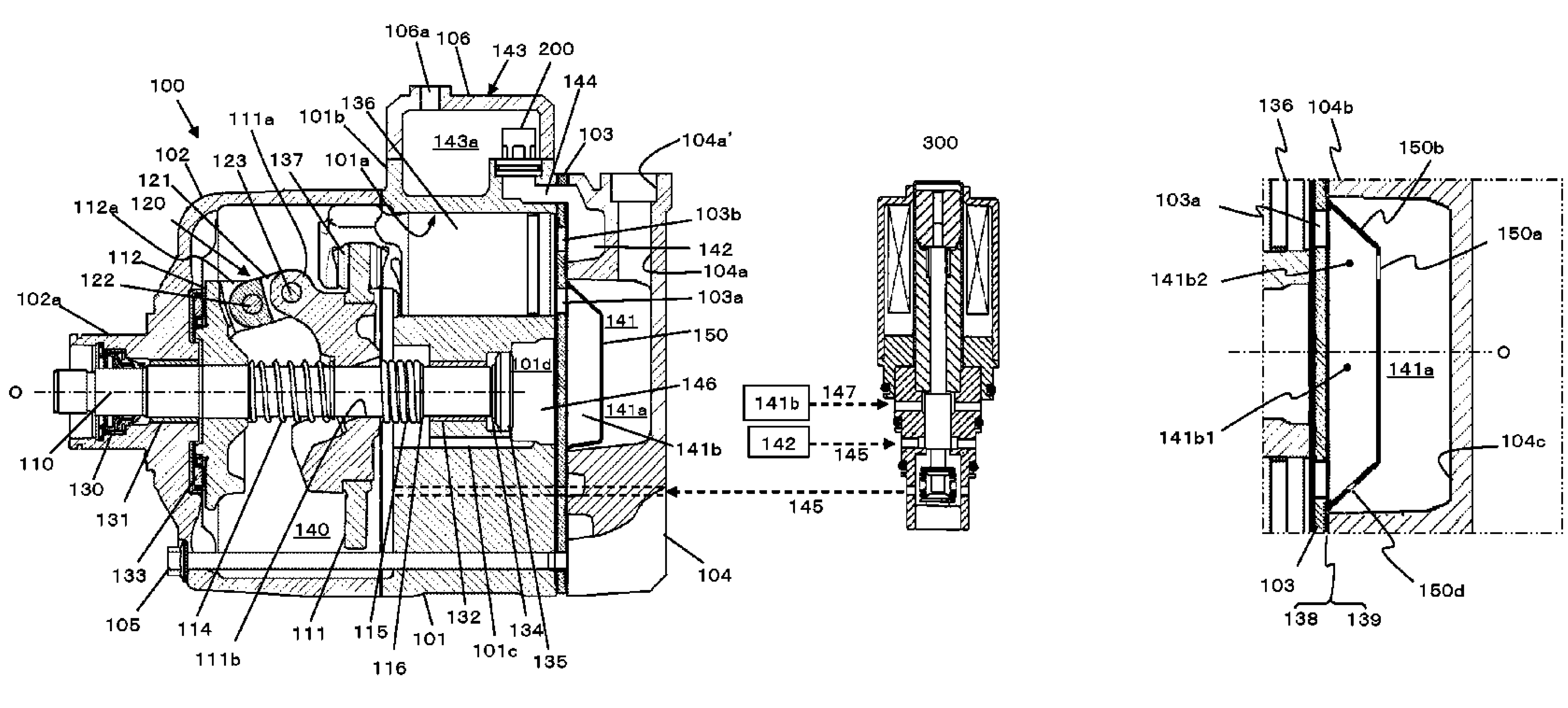

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FIG.1

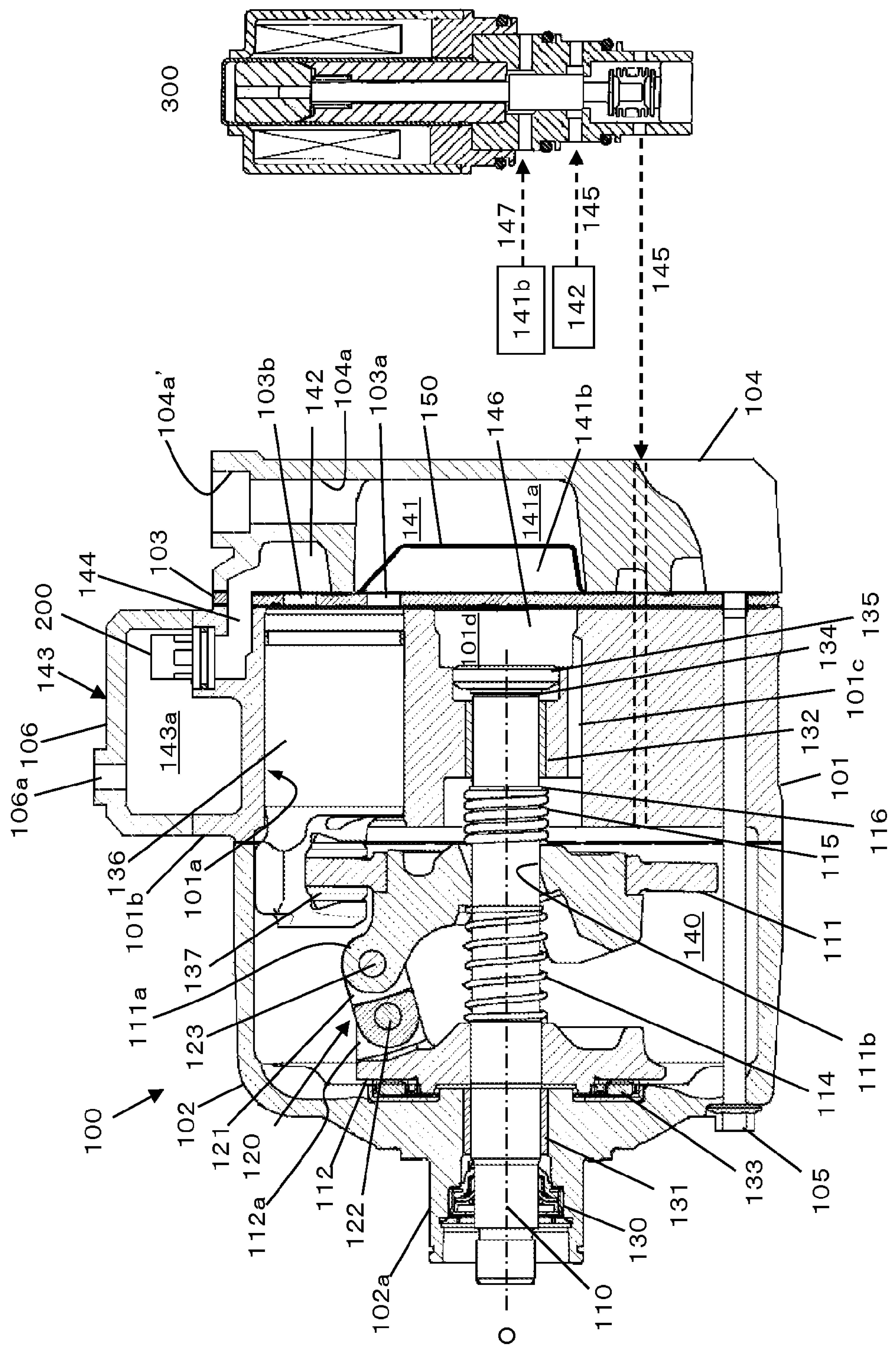

300
147
145
145
141b
142
104a'
103b
142
104a
103a
150
146
141b
104
141
141a
144
103
200
143
106
106a
143a
101d
135
134
101c
132
101
116
115
136
101b
101a
137
111
140
111a
123
111b
114
102
121
120
112a
112
122
133
105
131
130
110
102a
100
O

FIG.2

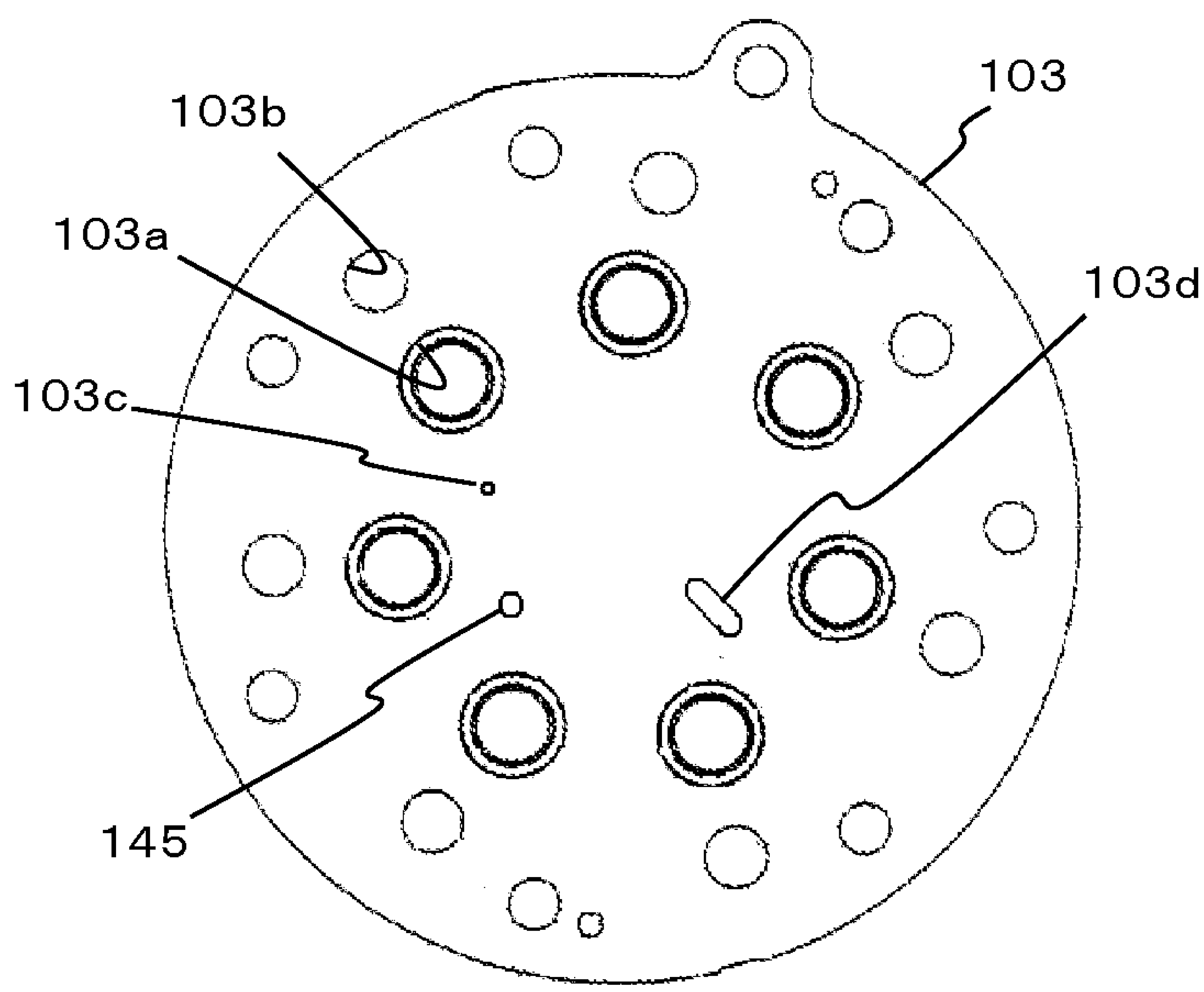


FIG.3

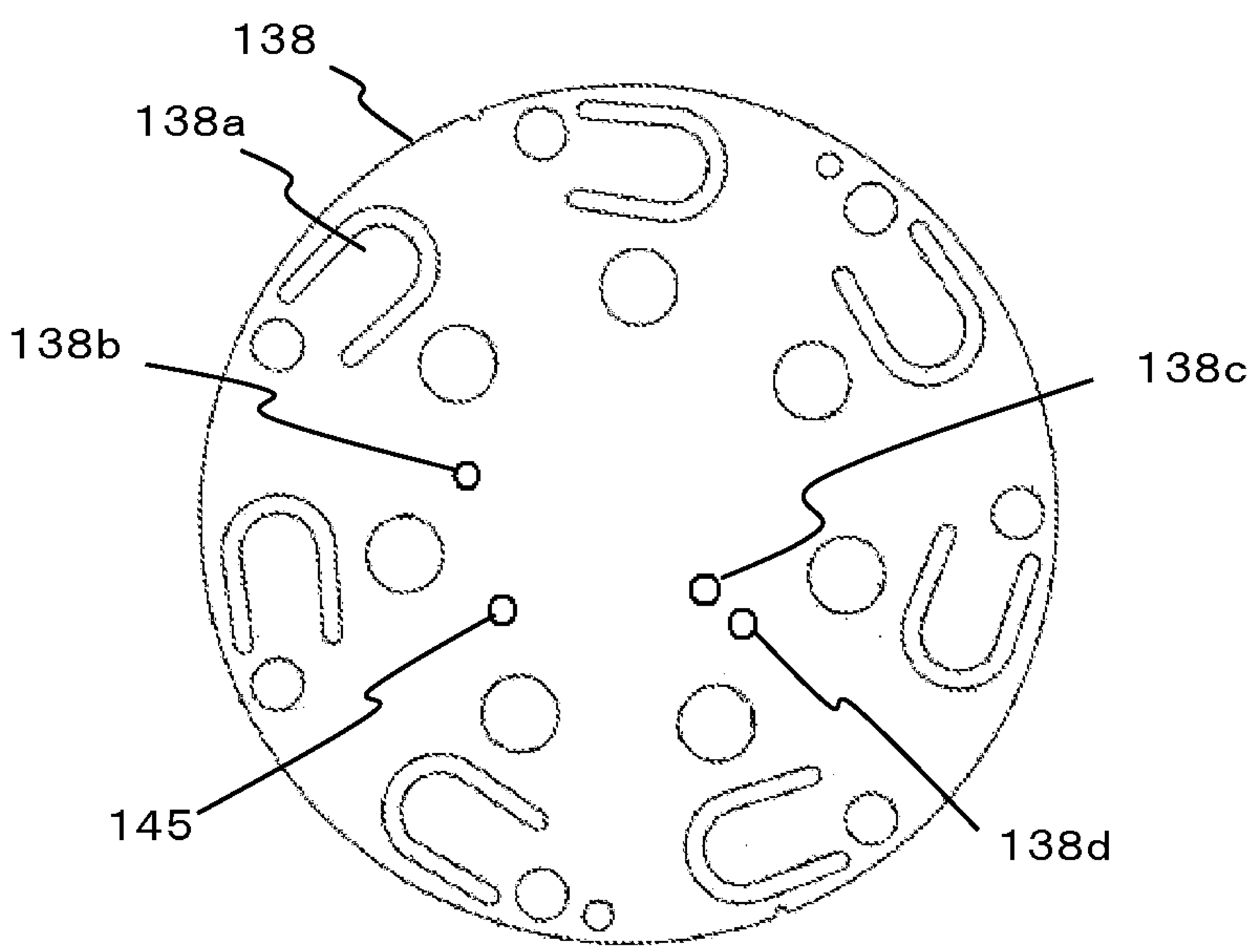


FIG.4

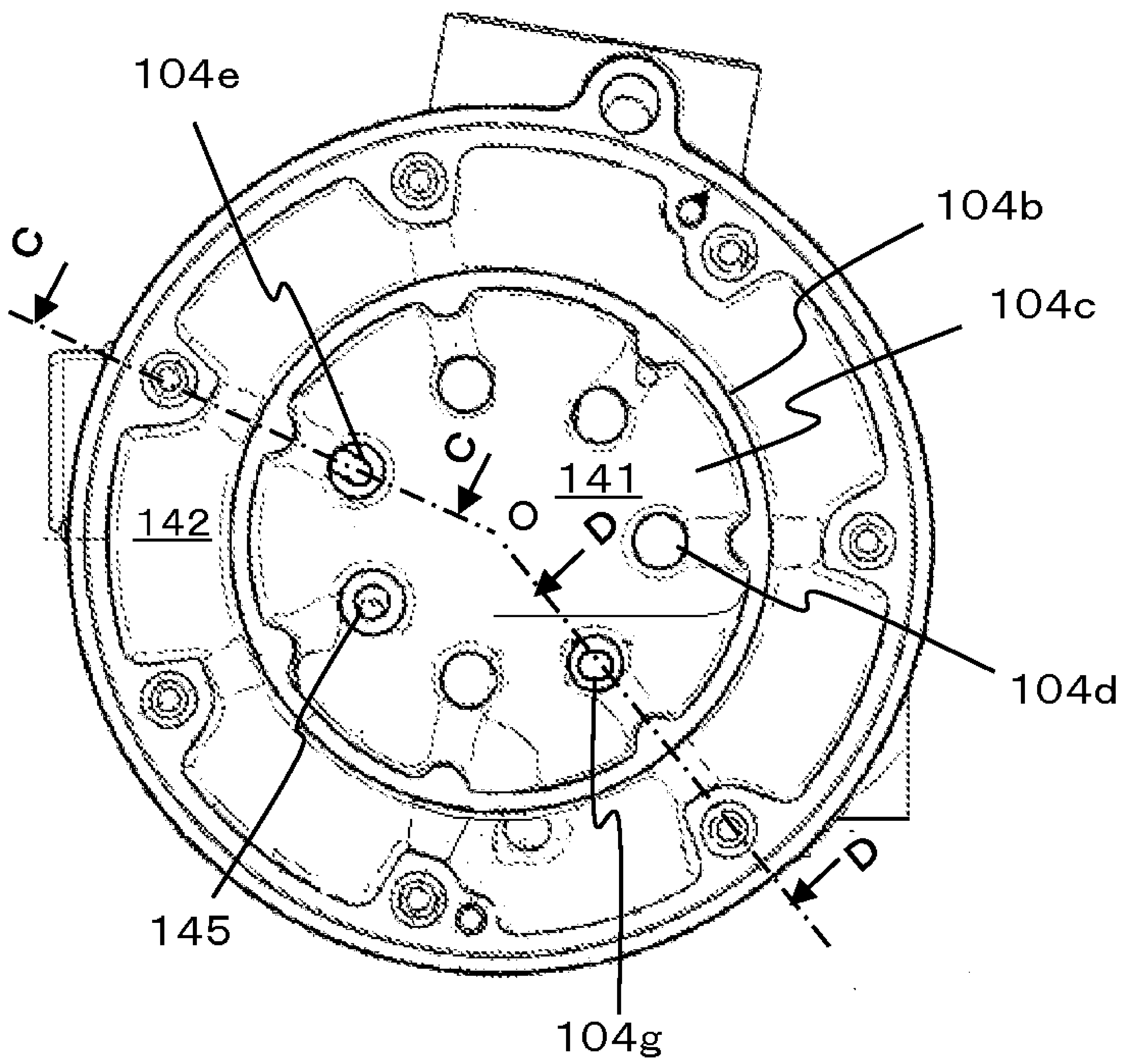


FIG.5

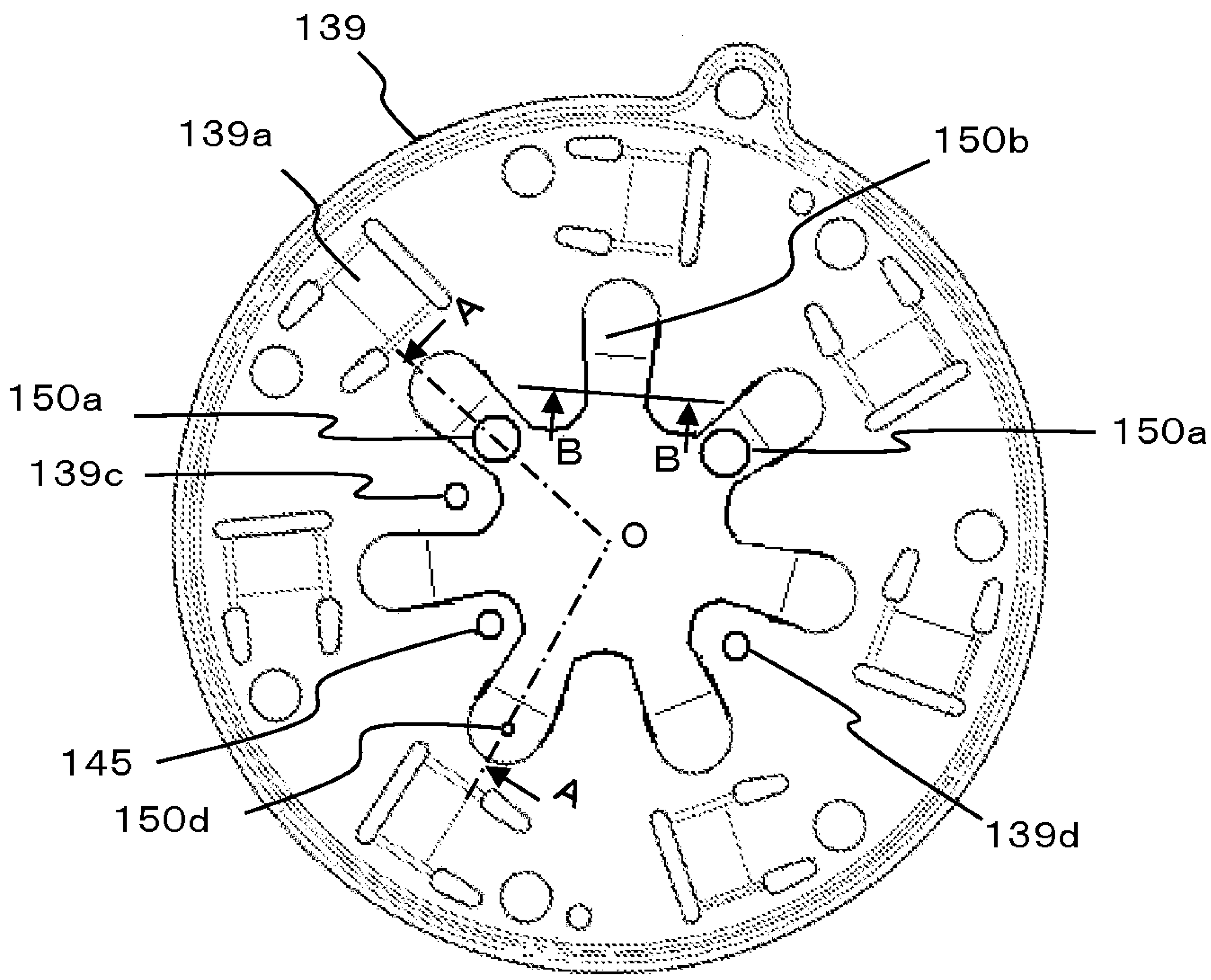


FIG.6

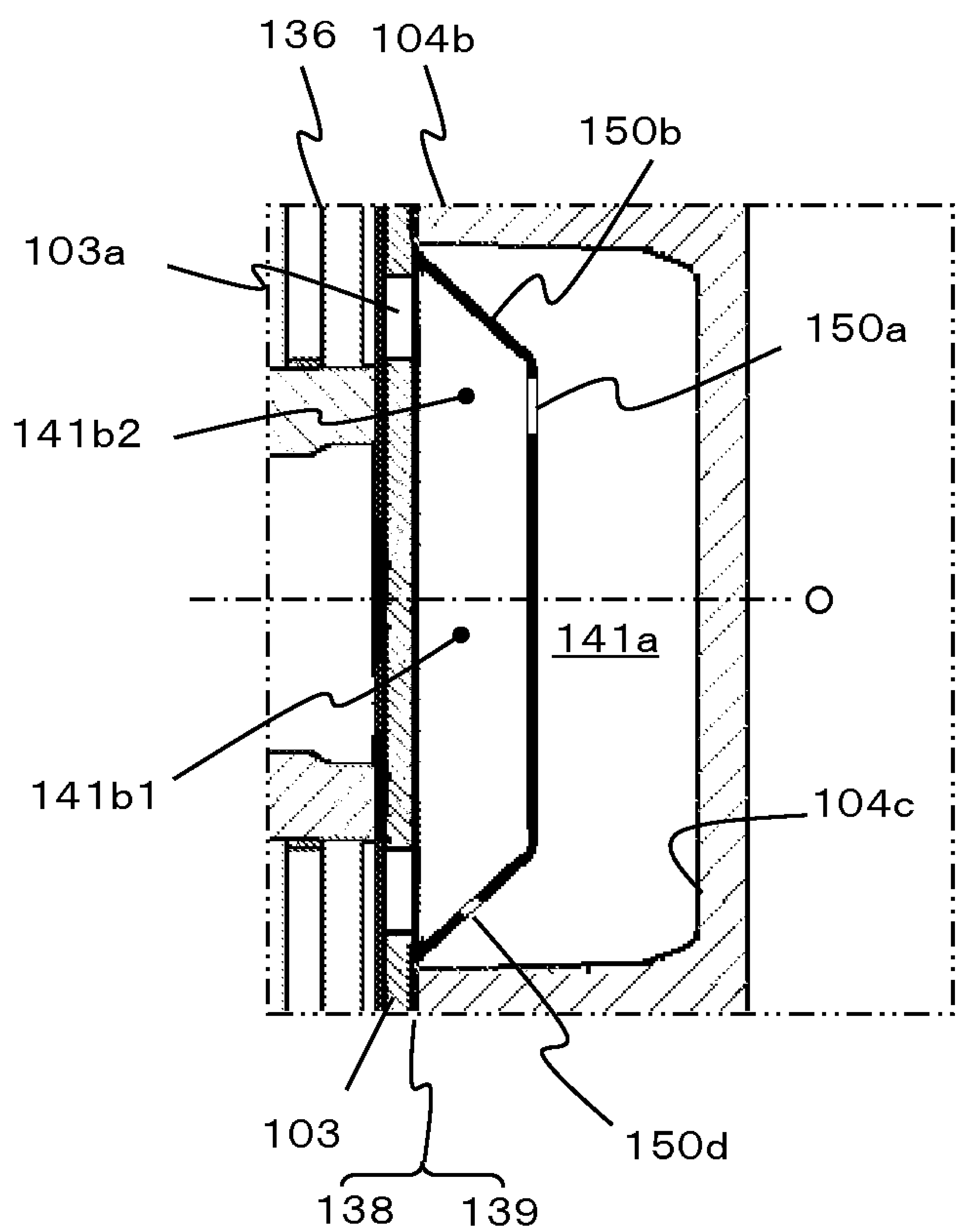

136
104b
150b
103a
150a
141b2
O
141a
141b1
104c
103
150d
138
139

FIG.7

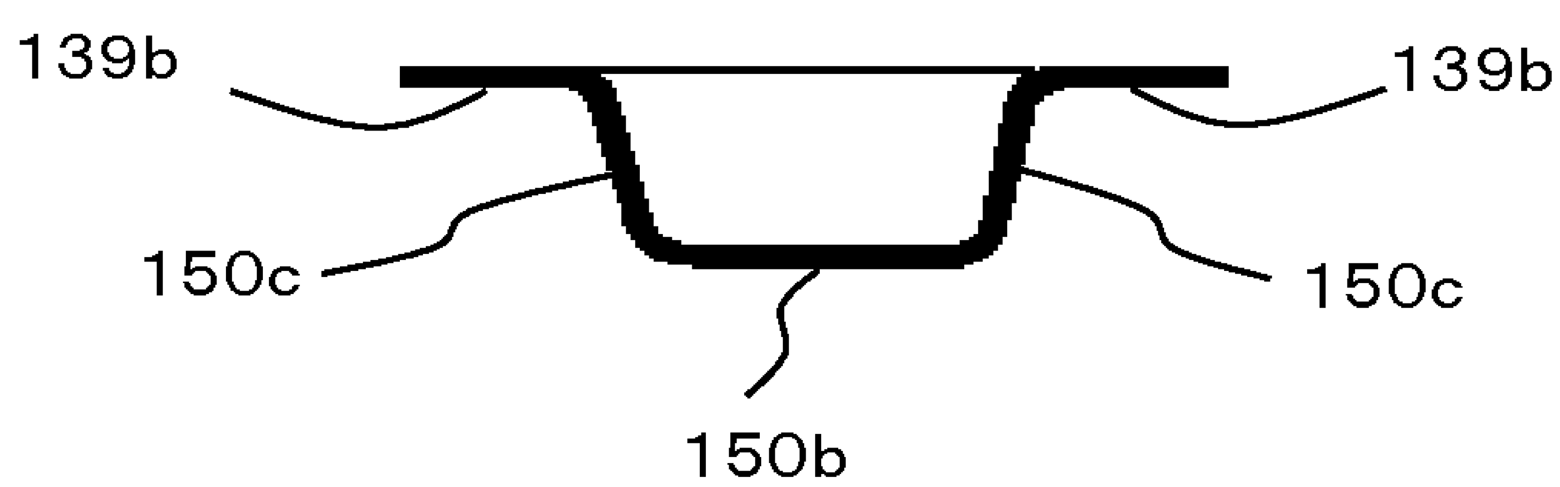
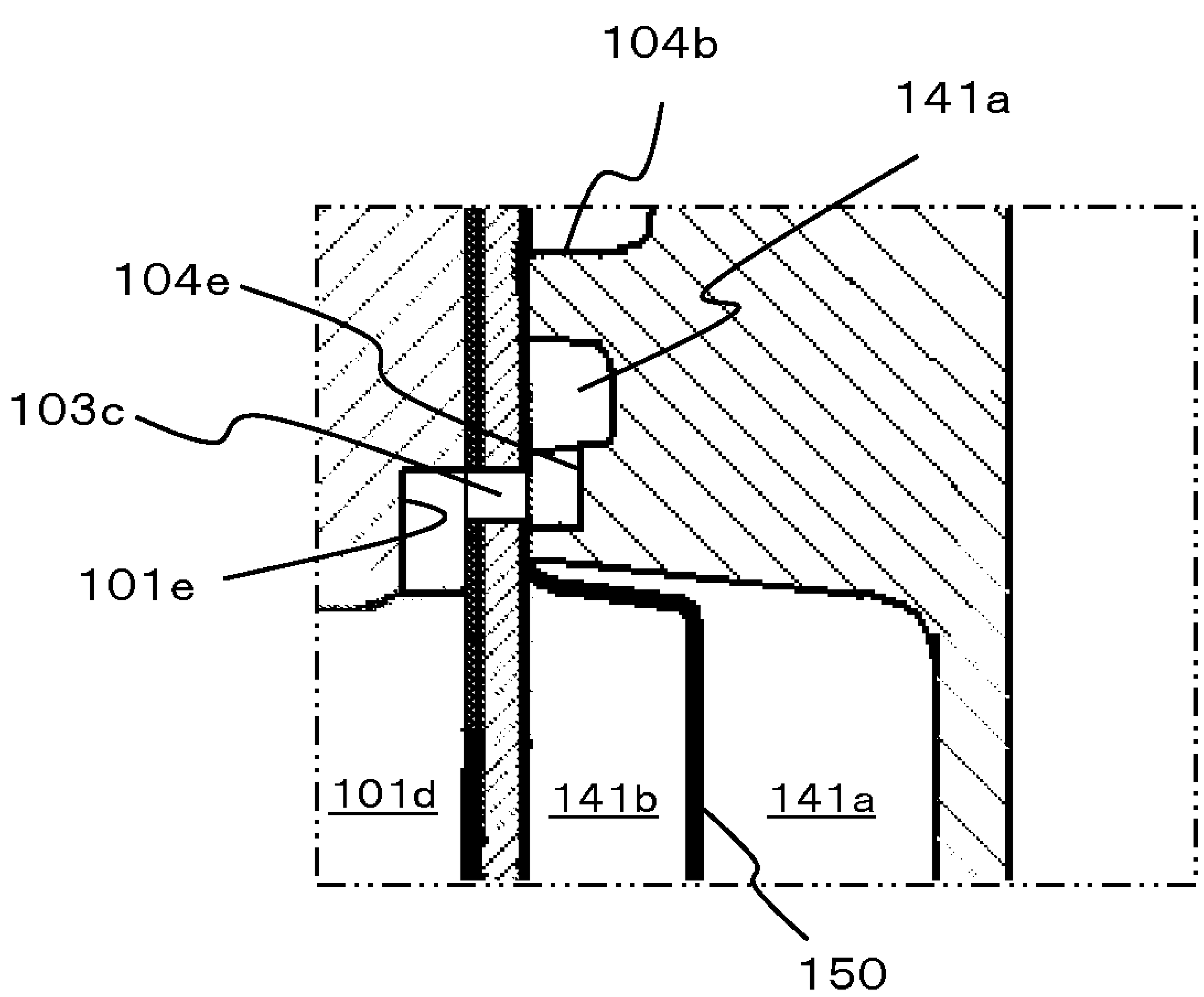


FIG.8



COMPRESSOR

RELATED APPLICATIONS

This is a U.S. National Phase Application under 35 USC 371 of International Application PCT/JP2013/080161 filed on Nov. 7, 2013.

This application claims the priority of Japanese application no. 2012-245724 Nov. 7, 2012, the entire content of which is hereby incorporated by reference.

TECHNICAL FIELD

The present invention relates to a compressor for compressing refrigerant gas including lubricating oil, and more particularly, relates to a technique for reducing the amount of lubricating oil flowing out from the compressor to an external refrigerant circuit.

BACKGROUND ART

In a conventional compressor for use in a vehicle air conditioner system, lubricating oil is mixed with refrigerant gas, and components and the like of the compressor in a crank chamber are lubricated thereby. In this case, when the lubricating oil flows out to an external refrigerant circuit for heat exchange, the efficiency of the system is reduced. Therefore, it is desired to reduce the amount of lubricating oil flowing out from the compressor to the external refrigerant circuit, and more specifically, it is desired to reduce an oil circulation rate (OCR).

For this reason, for example, in a compressor disclosed in Patent Document 1, a centrifugal separation-type oil separator is provided in a discharge passage extending from a discharge chamber, so as to separate lubricating oil, to thereby reduce the amount of the lubricating oil flowing out of the discharge passage, and thus, the OCR can be reduced. In a compressor disclosed in Patent Document 2, a centrifugal separation-type oil separator is provided in a passage that allows a crank chamber and a suction chamber to be in communication with each other, so as to separate lubricating oil, to thereby cause the lubricating oil to return to the crank chamber. This reduces the amount of the lubricating oil flowing out from the crank chamber to the suction chamber, and thus, the OCR can be reduced.

REFERENCE DOCUMENT LIST

Patent Documents

Patent Document 1: Publication of Japanese Translation of PCT Application No. 2007/111194

Patent Document 2: Japanese Patent Application Laid-open Publication No. 2002-213350

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

However, in the compressor disclosed in Patent Document 1, the centrifugal separation-type oil separator is required to be provided in the discharge passage, and in addition, a storage chamber for storing separated oil is required to be provided separately, and this makes the structure complicated.

In the compressor disclosed in Patent Document 2, since the centrifugal separation-type oil separator is configured to be provided in the passage that allows the crank chamber and the suction chamber to be in communication with each other, the structure becomes complicated.

The present invention was made in view of such circumstances, and in particular, it is an object of the present invention to provide a compressor capable of reducing the OCR with a simple structure.

Means for Solving the Problems

In order to achieve the above object, a compressor according to the present invention is a compressor in which a piston is caused to reciprocate, so that a refrigerant gas drawn from a suction chamber via a suction hole is compressed and discharged, the compressor including: a partition member that divides the suction chamber, into which the refrigerant gas flows from a suction passage, into a first space connected to the suction passage and a second space connected to the suction hole; and a communication passage configured to allow the first space and the second space to be in communication with each other, and introduce the refrigerant gas, from which lubricating oil has been separated, from the first space to the second space.

Effects of the Invention

According to the compressor of the present invention, the partition member divides the suction chamber into the first space and the second space. The suction passage is connected to the first space, and the suction hole is connected to the second space. The refrigerant gas, from which the lubricating oil has been separated, is introduced from the first space to the second space directly connected to the suction hole via the communication passage. Therefore, the refrigerant gas from which the lubricating oil has been separated can be compressed and discharged.

In this manner, since the lubricating oil can be separated by using the first space, which is a portion of the suction chamber, this can reduce the amount of the lubricating oil flowing out to the external refrigerant circuit, and reduce the OCR, with a simple structure.

In addition, since the lubricating oil flowing out from the crank chamber is separated and stored in the first space, no excessive lubricating oil remains in the crank chamber, and this can reduce a decrease in oil viscosity during high speed rotation, and moreover, this can reduce the risk of accumulation of foreign matter in the crank chamber and abnormal wear of sliding portions inside the compressor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross sectional view illustrating a compressor according to an embodiment of the present invention.

FIG. **2** is a top plan view illustrating a valve plate according to the present embodiment.

FIG. **3** is a top plan view illustrating a discharge valve formation body illustrated in FIG. **1**.

FIG. **4** is a top plan view illustrating a cylinder head according to the present embodiment.

FIG. **5** is a top plan view illustrating a head gasket and a partition member according to the present embodiment.

FIG. **6** is a partial cross sectional view taken along with a line A-O-A of FIG. **5**.

FIG. **7** is a partial cross sectional view taken along with a line B-B of FIG. **5**.

FIG. **8** is a partial cross sectional view taken along with a line C-C of FIG. **4**.

MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will be hereinafter described in details with reference to the accompanying drawings.

FIG. **1** is a cross sectional view illustrating a swash plate-type variable displacement compressor **100**, which is an example of a compressor to which the present invention is applied. This variable displacement compressor **100** is connected to a refrigerant circuit (evaporator and condenser), not shown, and in the variable displacement compressor **100**, a piston **136** is caused to reciprocate, to compress refrigerant gas drawn from the refrigerant circuit and discharge the compressed refrigerant gas. In the present embodiment, the variable displacement compressor **100** is considered to be used for a vehicle air conditioner system.

As illustrated in FIG. **1**, the variable displacement compressor **100** includes a cylinder block **101** having multiple cylinder bores **101***a* of the piston **136** formed therein, a front housing **102** provided at one end of the cylinder block **101**, and a cylinder head **104** provided at the other end of the cylinder block **101** with a valve plate **103** and the like interposed therebetween.

A crank chamber **140** at the back of the piston **136** is formed by the cylinder block **101** and the front housing **102**, and a drive shaft **110** is provided to cross the inside of this crank chamber **140** and is supported to be able to rotate.

A swash plate **111** is disposed around a middle portion of the drive shaft **110** in the axial direction. A through hole **111***b* is formed in a central portion of the swash plate **111**, and the drive shaft **110** is inserted through the through hole **111***b*. The swash plate **111** is coupled with a rotor **112**, fixed to the drive shaft **110** and rotating integrally with the drive shaft **110**, via a linkage **120**. With this linkage **120**, the swash plate **111** rotates together with the drive shaft **110** and the rotor **112**, and the inclination angle of the swash plate **111** can be changed with respect to the axis of the drive shaft **110**.

The linkage **120** includes a first arm **112***a* provided to be in a protruding manner on the rotor **112**, a second arm **111***a* provided to be in a protruding manner on the swash plate **111**, and a link arm **121**, one end of which is rotatably coupled to the first arm **112***a* via a first connection pin **122**, and the other end of which is rotatably coupled to the second arm **111***a* via a second connection pin **123**.

The through hole **111***b* of the swash plate **111** is formed in such a shape that the swash plate **111** can incline within a range from the maximum inclination angle to the minimum inclination angle. In the present embodiment, the through hole **111***b* is formed with a minimum inclination angle limitation unit for limiting the inclination angle displacement (inclining motion) of the swash plate **111** in a direction to reduce the inclination angle by coming into contact with the drive shaft **110**. For example, where the inclination angle of the swash plate **111** is zero degrees (minimum inclination angle) when the swash plate **111** is perpendicular to the drive shaft **110**, the minimum inclination angle limitation unit is formed to allow the inclination angle displacement (inclining motion) until the inclination angle of the swash plate **111** becomes substantially zero degrees. On the other hand, the inclination angle displacement (inclining motion) of the swash plate **111** in a direction to increase the inclination angle is limited when the swash plate **111** comes into contact with the rotor **112**. Therefore, the inclination angle of the swash plate **111** becomes the maximum inclination angle when the swash plate **111** comes into contact with the rotor **112**.

The drive shaft **110** is attached with a disinclining spring **114** for biasing the swash plate **111** in a direction to decrease the inclination angle and an inclining spring **115** for biasing the swash plate **111** in a direction to increase the inclination angle in such a manner that the swash plate **111** is interposed between the disinclining spring **114** and the inclining spring **115**. More specifically, the disinclining spring **114** is attached between the swash plate **111** and the rotor **112**, and the inclining spring **115** is attached between the swash plate **111** and a spring support member **116** provided on the drive shaft **110**.

In this case, when the inclination angle of the swash plate **111** is the minimum inclination angle, the biasing force of the inclining spring **115** is configured to be greater than the biasing force of the disinclining spring **114**. For this reason, when the drive shaft **110** is not rotating, i.e., the variable displacement compressor **100** is at a stop, the swash plate **111** is at the position of an inclination angle (>minimum inclination angle) at which the biasing force of the disinclining spring **114** and the biasing force of the inclining spring **115** are balanced.

One end of the drive shaft **110** penetrates through a boss portion **102***a* of the front housing **102** and extends to the outside of the front housing **102**, and is coupled with a driving force transmission device (not shown). It should be noted that a shaft seal device **130** is inserted between the drive shaft **110** and the boss portion **102***a*, to form a seal between the inside of the crank chamber **140** and the outside.

The drive shaft **110** is supported by radial bearings **131**,**132** in the radial direction, and is supported by a thrust plate **134** in the thrust direction. It should be noted that the thrust plate **134** and the end portion of the drive shaft **110** at the side of the thrust plate **134** are adjusted to have a predetermined gap using an adjusting screw **135**. Thus, the driving force from the external driving source (not shown), is transmitted to the driving force transmission device, so that the drive shaft **110** rotates in synchronization with the driving force transmission device.

The rotor **112** is supported by the drive shaft **110** in the radial direction, and is supported by the thrust bearing **133** in the thrust direction.

The piston **136** is disposed in the cylinder bore **101***a*, and an outer peripheral portion of the swash plate **111** is accommodated in the inner side space of the end portion of the piston **136** protruding toward the crank chamber **140**, and the swash plate **111** is in synchronization with the piston **136** via a pair of shoes **137**. With the shoes **137**, the rotational motion of the swash plate **111** is converted into the reciprocating motion of the piston **136**, and the piston **136** reciprocates in the cylinder bore **101***a*.

In the cylinder head **104**, a suction chamber **141** disposed on an extension line of an axis O of the drive shaft **110** and a discharge chamber **142** disposed to enclose the suction chamber **141** in a ring manner, are divided therefrom and formed. The suction chamber **141** is in communication with each cylinder bore **101***a* via a suction hole **103***a* formed in the valve plate **103** interposed between the cylinder block **101** and the cylinder head **104**, and via a suction valve (not shown) formed on a suction valve formation body. The discharge chamber **142** is in communication with a corresponding cylinder bore **101***a* via a discharge valve **138***a* formed on the discharge valve formation body **138** and a discharge hole **103***b* formed in the valve plate **103**. The suction chamber **141** and the discharge chamber **142** are separated by a partition wall **104***b* (see FIG. **4**, FIG. **6** and FIG. **8**, described later). The partition wall **104***b* is formed substantially in a circular ring shape about the center of the axis O of the drive shaft **110**, and the entire suction chamber **141** is substantially in a circular shape.

In this case, the front housing **102**, the center gasket (not shown) cylinder block **101**, the cylinder gasket (not shown), the suction valve formation body (not shown), the valve plate **103**, the discharge valve formation body **138**, the head gasket **139**, and the cylinder head **104** are fastened with multiple through bolts **105**, to form a housing. FIG. **2** illustrates the valve plate **103**, FIG. **3** illustrates the discharge valve formation body **138**, FIG. **4** illustrates the cylinder head **104**, and FIG. **5** illustrates the head gasket **139**.

The cylinder head **104** is formed with a suction passage **104***a* having a connection port **104***a*', and this connection port **104***a*' is connected to a suction-side refrigerant circuit (evaporator) of the vehicle air conditioner system described above. Therefore, the refrigerant gas flows from the suction passage **104***a* into the suction chamber **141**. The suction passage **104***a* is provided to linearly extend from the outer periphery of the cylinder head **104** toward the suction chamber **141**, crossing a portion of the discharge chamber **142**.

The suction chamber **141** is divided by a partition member **150** into a first space **141***a* connected with the suction passage **104***a* and a second space **141***b* connected with the suction hole **103***a*. In the present embodiment, the partition member **150** is provided with a communication hole **150***a* that allows the first space **141***a* and the second space **141***b* to be in communication with each other, and that serves as a communication passage for introducing the refrigerant gas, from which the lubricating oil has been separated, from the first space **141***a* into the second space **141***b*. The partition member **150** and the communication hole **150***a* will be described later in detail.

As illustrated in FIG. **1**, at the outside of the cylinder block **101**, a muffler **143** is provided. The muffler **143** is formed by coupling a tubular lid member **106** with a bottom with a tubular wall **101***b* disposed perpendicularly on the outer surface of the cylinder block **101** with a seal member (not shown) interposed therebetween. The lid member **106** is formed with a discharge port **106***a*, and this discharge port **106***a* is connected to a discharge-side refrigerant circuit (condenser) of the vehicle air conditioner system. A communication passage **144** for allowing the discharge chamber **142** and a muffler space **143***a* in the muffler **143** to be in communication with each other is formed to extend through the cylinder block **101**, the valve plate **103**, and the cylinder head **104**. The muffler space **143***a*and the communication passage **144** form a discharge passage for allowing communication between the discharge chamber **142** and the discharge port **106***a*, and the muffler **143** forms the muffler space **143***a* along the discharge passage.

A check valve **200** for opening and closing an inlet of the muffler **143** is disposed in the muffler **143**. The check valve **200** is disposed at a connection portion between the communication passage **144** and the muffler space **143***a*, and operates in response to a pressure difference between the communication passage **144** (upstream side) and the muffler space **143***a* (downstream side), and for example, when a difference (pressure difference) between the pressure in the communication passage **144** (upstream-side pressure) Pu and the pressure in the muffler space **143***a* (downstream-side pressure) Pd is greater than a predetermined value SL ($Pu-Pd>SL>0$), the check valve **200** opens, and when the pressure difference is equal to or less than the predetermined value SL, the check valve **200** closes.

The cylinder head **104** is further provided with a control valve **300**.

The control valve **300** adjusts the degree of opening of a pressure supply passage **145** that allows communication between the discharge chamber **142** and the crank chamber **140**, thus controlling the amount of introduction of the discharge gas to the crank chamber **140**.

The refrigerant gas in the crank chamber **140** flows via a pressure releasing passage **146** (described later in detail) to the suction chamber **141** (first space **141***a*).

Therefore, the control valve **300** adjusts the amount of the discharge refrigerant introduced into the crank chamber **140** to change the pressure in the crank chamber **140**, thus changing the inclination angle of the swash plate **111**, i.e., the stroke of the piston **136**, so that the capacity of the discharge of the variable displacement compressor **100** can be variably controlled.

More specifically, the control valve **300** adjusts the amount of electricity passed to a solenoid provided therein on the basis of an external signal, and variably controls the discharge capacity so that the pressure of the suction chamber **141** (second space **141***b*) introduced into a pressure sensing chamber of the control valve **300** via the pressure introducing passage **147** (described later in details) reaches a predetermined value. Alternatively, the control valve **300** cuts off electricity passed to the solenoid, and the control valve **300** forcibly opens the pressure supply passage **145** to perform control to make the discharge capacity of the variable displacement compressor **100** the minimum.

Hereinafter, in particularly, the partition member **150**, the communication hole **150***a*, and the pressure releasing passage **146**, which relate to the structure for reducing the OCR, will be described in detail with reference to FIGS. **2** to **8**.

As described above, the partition member **150** divides the suction chamber **141** into the first space **141***a* connected with the suction passage **104***a* and the second space **141***b* connected with the suction hole **103***a*. In this manner, the suction chamber **141** is divided into the second space **141***b* directly connected to the suction hole **103***a* and the first space **141***a* that is a space at the upstream side of the second space. As described later, the partition member **150** is formed such that the head gasket **139** is caused to protrude, and as illustrated in FIGS. **5** and **6**, the second space **141***b* includes a central space **141***b***1** and a guiding passage **141***b***2** provided to extend from the central space **141***b***1** to each suction hole **103***a* in a radial manner and guiding the suction refrigerant gas. As illustrated in FIG. **7**, the guiding passage **141***b***2** is formed with a bottom wall **150***b* and side walls **150***c*, and as illustrated in FIG. **6**, the bottom wall **150***b* is formed with an inclination wall portion so that the size of the passage in cross section decreases toward the suction hole **103***a*.

The communication hole **150***a* formed in the partition member **150** is formed at a position at the upper side in the gravity direction of the first space **141***a*, for example, the upper side in the gravity direction with respect to the axis O of the drive shaft **110** (the upper side in FIGS. **1** to **5** is the upper side in the gravity direction) so as to allow the first space **141***a* and the second space **141***b* to be in communication with each other. It should be noted that the communication hole **150***a* is open at a position away from an area on an extension of the suction passage **104***a* into the suction chamber **141**, so that the mainstream of the refrigerant gas flowing from the suction passage **104**a to the first space **141**a does not directly flow into the second space **141**b at the downstream side.

In this case, the second space **141**b directly connects to the suction hole **103**a, and is separated from the suction passage by the partition member **150**. Therefore, the second space **141**b is substantially a suction chamber, and the first space **141**a directly connected to the suction passage can be deemed as a portion of the suction passage, and the communication hole **150**a is substantially an outlet of the suction passage. For example, the communication hole **150**a is formed at the upper side in the gravity direction with respect to the axis O of the drive shaft **110** so as to allow the first space **141**a and the second space **141**b to be in communication, so that the first space **141**a serves as an oil storage chamber for storing the lubricating oil flowing back from the vehicle air conditioner system together with the suction refrigerant gas. In this manner, the communication hole **150**a allows communication between the first space **141**a and the second space **141**b, introduces the refrigerant gas, from which the lubricating oil has been separated, from the first space **141**a to the second space **141**b.

Multiple protruding units **104**d for pressing, toward the valve plate, the peripheral edge portion of the partition member of the head gasket **139** are formed in a protruding manner on the suction chamber forming wall surface of the cylinder head **104** facing the valve plate **103**. More specifically, the protruding unit **104**d extends from the bottom wall **104**c of the cylinder head **104** (suction chamber forming wall surface) so as to press the areas between adjacent guiding passages **141**b**2**, and the protruding unit **104**d presses the valve plate **103** via the head gasket **139** and the discharge valve formation body **138**. The protruding units **104**d are annularly arranged at regular intervals around the center of the cylinder head **104** (see FIG. **4**). The suction holes **103**a (see FIG. **2** and the like) formed in the valve plate **103** are at the same distance from the axis O of the drive shaft **110**, and are annularly arranged at regular intervals around the axis of the drive shaft **110**.

For example, the partition member **150** is formed such that the portion facing the suction chamber **141** of the head gasket **139** protrudes into the suction chamber. More specifically, the area of the head gasket **139** corresponding to the suction chamber **141** is caused to protrude, and thus, the partition member **150** is formed by using the head gasket **139**. Therefore, it is not necessary to add an additional component as the partition member **150**, and in addition, it is not necessary to separately add a structure for fixing the partition member **150** into the suction chamber **141**. Therefore, this can prevent an increase in cost caused by providing the partition member **150**. The head gasket **139** is made by coating a thin plate of metal with rubber, and the partition member **150** is pressed integrally with the head gasket **139** and has rubber coating applied thereto. The head gasket **139** is formed with a retainer **139**a for limiting the degree of opening of the discharge valve **138**a, in the area corresponding to the discharge chamber **142** at the outside in the diameter direction.

On both sides of the side wall **150**c at the forming portion of the guiding passage **141**b**2** of the partition member **150**, a flat portion **139**b of the head gasket **139** is provided. The protruding unit **104**d presses the flat portion **139**b, so that the partition member **150** can be reliably held on the valve plate **103**.

For example, out of the guiding passages **141**b**2**, a guiding passage **141**b**2** disposed at the lower side in the gravity direction with respect to the axis O of the drive shaft **110** has the bottom wall **150**b provided with a small hole **150**d that allows communication between the first space **141**a and the guiding passage **141**b**2** (more specifically, second space **141**b) (see FIGS. **5** and **6**). It should be noted that the small hole **150**d is configured to have the size of area of the aperture and the height from the bottom of the first space **141**a serving as the storage chamber so as to store an appropriate amount of oil in the first space **141**a.

The pressure releasing passage **146** allows the first space **141**a and the crank chamber **140** provided at the back of the piston **136** to be in communication with each other and configured to discharge the pressure in the crank chamber, and includes, for example, a communication passage **101**c formed to be in parallel with the drive shaft **110** in the cylinder block **101** (see FIG. **1**), a space **101**d formed at the side of the end portion of the drive shaft **110** (see FIGS. **1** and **8**), a communication passage **101**e formed at an end surface of the cylinder block **101** at the side of the cylinder head **104** (see FIG. **8**), a communication hole (not shown) formed on each of the cylinder gasket and the suction valve formation body, an orifice **103**c formed in the valve plate **103** (see FIGS. **2** and **8**), a communication hole **138**b formed in the valve formation body **138** (see FIG. **3**), a communication hole **139**c formed in the head gasket **139** (see FIG. **5**), and a groove **104**e formed on an end surface of the protruding unit **104**d and in communication with the first space **141**a (see FIG. **8**). Therefore, the refrigerant gas including the lubricating oil in the crank chamber **140** flows via the pressure releasing passage **146** into the first space **141**a.

The pressure releasing passage **146** is connected to the first space **141**a at the upper side in the gravity direction of the first space **141**a, for example, at the upper side in the gravity direction with respect to the axis O of the drive shaft **110**. More specifically, the groove **104**e of the pressure releasing passage **146** is connected to the first space **141**a at the upper side in the gravity direction with respect to the axis O of the drive shaft **110**, and as illustrated in FIG. **4**, this groove **104**e extends toward the partition wall **104**b.

Subsequently, the action of the variable displacement compressor **100** having the above configuration will be described with reference to FIGS. **6** to **8**.

The refrigerant gas flowing from the suction passage **104**a into the first space **141**a flows via the communication hole **150**a to the second space **141**b, and flows along the guiding passage **141**b**2** to each suction hole **103**a. In this case, when the lubricating oil from the air conditioner system flows back together with the refrigerant gas from the suction passage **104**a, this lubricating oil stays at the bottom of the first space **141**a serving as the storage chamber due to its own weight, and is separated from the refrigerant gas. Then, the refrigerant gas from which the lubricating oil that has been separated is introduced through the communication hole **150**a from the first space **141**a to the second space **141**b, and the refrigerant gas in the second space **141**b is introduced into the cylinder bore **101**a via the suction hole **103**a, and then, the refrigerant gas is compressed by the piston **136** and is discharged, so that this reduces the amount of lubricating oil flowing out from the variable displacement compressor **100** to the vehicle air conditioner system. On the other hand, when the lubricating oil stored in the crank chamber **140** flows via the pressure releasing passage **146** from the crank chamber **140** to the first space **141**a, this lubricating oil likewise stays in the first space **141**a due to its own weight, and is separated from the refrigerant gas. Even in this case, the refrigerant gas from which the lubricating oil has been separated is introduced through the communication hole **150**a into the second space **141**b, and this prevents the lubricating oil from flowing to the second space **141***b* and further to the external refrigerant circuit. In this case, when the oil height of the lubricating oil held in the first space **141***a* exceeds the height of the small hole **150***d*, the lubricating oil flows back from the first space **141***a* to the second space **141***b*, so that this contributes to lubrication of each unit of the variable displacement compressor **100**.

As described above, according to the variable displacement compressor **100** of the present embodiment, the partition member **150** divides the suction chamber **141** into the first space **141***a* and the second space **141***b*, and the suction passage **104***a* is connected to the first space **141***a*, and the suction hole **103***a* is connected to the second space **141***b*, and the refrigerant gas from which the lubricating oil has been separated is introduced from the first space **141***a* to the second space **141***b* directly connected to the suction hole **103***a* via the communication passage **150***a*. Therefore, even when the lubricating oil flows back together with the refrigerant gas from the air conditioner system and flows into the suction chamber **141**, the refrigerant gas from which the lubricating oil has been separated can be compressed and discharged.

Since the pressure releasing passage **146** is connected to the first space **141***a*, which is on the upstream side of the second space **141***b*, even if the lubricating oil flows out together with the refrigerant gas from the crank chamber **140** to the suction chamber **141** via the pressure releasing passage **146**, the refrigerant gas from which the lubricating oil has been separated is introduced from the first space to the second space via the communication passage. Therefore, the refrigerant gas from which the lubricating oil has been separated can be compressed and discharged.

As described above, the lubricating oil can be separated by using the first space **141***a* which is a part of the suction chamber **141**. Therefore, with the simple structure, the lubricating oil flowing out to the external refrigerant circuit can be prevented, and the OCR can be reduced.

In addition, since the lubricating oil flowing out from the crank chamber is separated and stored in the first space, no excessive lubricating oil remains in the crank chamber, and this can reduce a decrease in oil viscosity during high speed rotation, and moreover, this can reduce the risk of accumulation of foreign matter in the crank chamber and abnormal wear of sliding portions inside the compressor. In the first space **141***a*, a high temperature lubricating oil flowing out from the crank chamber **140** can be cooled by the refrigerant gas drawn thereinto from the suction passage **104***a*, and this can reliably prevent the decrease in viscosity of the lubricating oil.

Furthermore, the first space **141***a* not only stores the lubricating oil but also functions as a liquid storage space for liquid refrigerant returning from the vehicle air conditioner system, thus reducing the risk of compressing the liquid refrigerant with the piston **136**.

Since each suction hole **103***a* is partitioned by formation walls forming the guiding passage **141***b***2** (the bottom wall **150***b* and the side walls **150***c*), this can make the refrigerant gas smoothly flow toward each suction hole **103***a*. In addition, mutual interference of the suction refrigerant gas flowing to each suction hole **103***a* can be prevented. Therefore, the suction pressure pulsation level can be reduced.

Furthermore, since the pressure releasing passage **146** (groove **104***e*) is connected at the upper side in the gravity direction of the first space **141***a*, for example, at the upper side in the gravity direction with respect to the axis O of the drive shaft **110**, when, for example, the liquid surface of the lubricating oil stored in the first space **141***a* is located at the lower side in the gravity direction with respect to the axis O of the drive shaft **110**, the lubricating oil stored in the first space **141***a* is less likely to be agitated by the refrigerant gas flowing from the crank chamber **140** to the first space **141***a*, and this can prevent the stored oil from spattering and flowing out from the communication hole **150***a* to the second space **141***b*, and furthermore, this can prevent the oil from flowing out to the external refrigerant circuit, thus achieving greater reduction of the OCR.

Since the communication passage (communication hole **150***a*) that allows the first space **141***a* and the second space **141***b* to be in communication with each other is formed in the partition member **150**, the position adjustment of the communication passage can be done at the same time as the position adjustment of the partition member **150**, so that the position adjustment of the communication passage can be done easily. In FIG. **5**, two communication holes **150***a* are formed, but there may be one communication hole **150***a*, or there may be three or more communication holes **150***a*. FIG. **6** shows a case in which the communication passage **150***a* that allows the first space **141***a* and the second space **141***b* to be in communication with each other is formed by simply penetrating through the partition member **150**, but the embodiment is not limited thereto. Alternatively, a tubular wall may be formed to protrude toward the first space **141***a*. In this case, the lubricating oil separation effect can be further improved at the first space **141***a*. The structure of improving the lubricating oil separation effect is not limited to the structure of forming the communication passage **150***a* with the tubular wall described above, but it may be of other structures. In the foregoing, the communication passage (communication hole **150***a*) that allows the first space **141***a* and the second space **141***b* to be in communication with each other is formed in the partition member **150**, but the embodiment is not limited thereto. For example, a passage may be separately provided with a pipe and the like.

The contents of the present invention have been described in a specific manner with reference to preferable embodiments, but it is obvious to one skilled in the art that it is possible to employ various kinds of modified aspects on the basis of basic technical concepts and teachings of the present invention.

In the present embodiment, the partition member **150** is integrally formed with the head gasket **139**, but the embodiment is not limited thereto. The partition member **150** may be formed separately from the head gasket **139**.

In the foregoing, the pressure releasing passage **146** is connected to the first space **141***a* at the upper side in the gravity direction with respect to the axis O of the drive shaft **110**, but the embodiment is not limited thereto. For example, the pressure releasing passage **146** may be connected to the first space **141***a* at the lower side in the gravity direction with respect to the axis O of the drive shaft **110**, and the lubricating oil stored in the first space **141***a* when the rotation of the variable displacement compressor **100** is stopped may be returned to the side of the crank chamber **140**.

The small hole **150***d* is formed to allow the first space **141***a* and the second space **141***b* to be in communication with each other, but the embodiment is not limited thereto. The small hole **150***d* may be formed to allow the first space **141***a* and the crank chamber **140** to be in communication with each other. In this configuration, when the rotation of the variable displacement compressor **100** is stopped, the lubricating oil stored in the first space **141***a* can be returned to the crank chamber **140**.

The compressor **100** may not only be a swash plate-type variable displacement compressor but also a wobble plate-type variable displacement compressor. Furthermore, the invention of the present application can be applied to various kinds of known compressors such as a variable displacement compressor having an electromagnetic clutch, a clutch-less compressor having no electromagnetic clutch, a fixed-capacity type reciprocal compressor, a reciprocal compressor driven by a motor, and the like.

REFERENCE SYMBOL LIST

100 Compressor (variable displacement compressor)
103 Valve plate
103*a* Suction hole
104 Cylinder head
104*a* Suction passage
104*d* Protruding unit
136 Piston
139 Head gasket
140 Crank chamber
141 Suction chamber
141*a* First space
141*b* Second space
146 Pressure releasing passage
150 Partition member
150*a* Communication passage (communication hole)

The invention claimed is:

1. A compressor in which a piston is caused to reciprocate, so that a refrigerant gas drawn from a suction chamber via a suction hole is compressed and discharged, the compressor comprising:

a partition member that divides the suction chamber, into which the refrigerant gas flows from a suction passage, into a first space for separating lubricating oil from the refrigerant gas, the first space being connected to the suction passage, and a second space connected to the suction hole; and

a pressure releasing passage configured to allow the first space and a crank chamber provided at the back of the piston to be in communication with each other, and to discharge a pressure in the crank chamber,

wherein, in the partition member, a communication passage configured to allow the first space and the second space to be in communication with each other, and introduce the refrigerant gas, from which the lubricating oil has been separated, from the first space to the second space, is formed, and a small hole configured to allow the first space and the second space to be in communication with each other, and allow the lubricating oil stored in the first space to return to the second space, is formed.

2. The compressor according to claim **1**,

wherein the pressure releasing passage is connected at an upper side in a gravity direction with respect to an axis of a drive shaft, and

wherein the small hole is disposed at a lower side in the gravity direction with respect to the axis of the drive shaft.

3. The compressor according to claim **1**, wherein the small hole is configured to have a size of an aperture area and a height from the bottom of the first space so as to store a predetermined amount of the lubricating oil in the first space.

4. The compressor according to claim **1**, wherein the partition member is formed such that a portion, facing the suction chamber, of a head gasket interposed between a valve plate having the suction hole formed therein and a cylinder head having the suction chamber formed therein, is caused to protrude into the suction chamber.

5. The compressor according to claim **4**,

wherein the suction chamber is configured to be disposed on an extension line of an axis of a drive shaft, and

wherein a protruding unit for pressing, toward the valve plate, a peripheral edge portion of the partition member of the head gasket, is formed in a protruding manner on a suction chamber forming wall surface of the cylinder head facing the valve plate.

6. The compressor according to claim **4**,

wherein the suction chamber is configured to be disposed on an extension line of an axis of a drive shaft, and

wherein the second space includes a central space, and a guiding passage provided to extend from the central space to the suction hole and guiding the refrigerant gas.

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